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Regional CH_4 flux estimates based on GOSAT and ground-based observations

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Monthly CH_4 fluxes for 43 regions in 2009-2010 are estimated by an inverse model using the GOSAT SWIR Level 2 X_{CH4} data and ground-based CH_4 observations archived at WDCGG. The flux estimates and global distribution of methane concentrations in the atmosphere are prepared for a distribution as the GOSAT Level 4 research product. We used interannually varying CH_4 emissions by the GFED and VISIT ecosystem model and the interannually repeating EDGAR CH_4 emissions and chemical sink fields prepared by the TransCom-CH4 project in a forward simulation by the NIES transport model. Scale adjustments were applied to 4 categories of fluxes independently for each region. The inverse problem of optimizing the fluxes was solved with a fixed-lag Kalman smoother. We compared the inversion results using the two different datasets to assess the utility of GOSAT X_{CH4} data in flux estimates and found good fit to the data with chi-square values of 0.7 and 1.2 with fluxes estimated using ground-based data only and both ground-based and GOSAT data, respectively. Mean residual misfit between simulations and GOSAT data is 5 ppb, which is smaller than difference with TCCON and GOSAT observations. The inversion using ground-based data only estimated larger uncertainty of fluxes over tropical regions, South America and Temperate Asia where the data are sparse. Adding large number of the GOSAT data to the inversion leads to decreasing the uncertainty in Temperate Asia (by 41%), northern South America (26%), Tropical Asia (24%), Europe (23%) and other regions. Monthly mean X_{CH4} simulated with fluxes estimated using the ground-based data is close to the GOSAT observations in the north of 40˚N, but lower than GOSAT in southern hemisphere, and the difference can be attributed to possible biases in X_{CH4} observations and the transport model. Authors acknowledge contribution of the ground-based FTS data by TCCON partners.